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Septimò, Utrum componentes cuiusvis miscela colores revera mutentur; an vero secernantur duntaxat, quando ex mixtura illa varii colores rursum producuntur per Refractionem?

Ottavò, Denturne ulli alii colores Refractione producti prater eos, quos oriri oportet à Coloribus, ad radios diversimode refrangibiles pertinentibus, dum illi refractione ista secernuntur vel miscentur?

Per Experimenta determinare hec similiave *Quæsita*, que propositam Theorian involunt, maximè genuina directaque videtur ad Conclusionem via: Proindeque omnes velim Objectiones suspendi, que ab Hypothesibus desumuntur ullisive Fontibus aliis, quam his duobus; quibus nempe vel ostendatur Experimentorum ad determinanda hec *Quæsita* probandaive ullas arias Theoria mea partes insufficientia, hallucinationes defectusque in Conclusionibus meis inde deductis indigitando; vel alia producantur Experimenta, è diametro mihi opposita, si que talia occurrere videantur. Si enim Experimenta, que à me urgentur, laborant defectibus, difficile hanc fuerit eos ostendere; si vero valida fuerint, eo ipso dum Theoriam meam afferunt probantque omnes Objectiones convallunt.

Some Annotations of the Learned Dr. Walter Needham upon a Discovery pretended to have been made by the famous Monsieur Pecquet of a Communication between the Ductus Thoracicus and the Inferior Vena Cava.

The Relation it self of that pretended Discovery, as it is to be found in the Journal des Scavans, of Feb. 8. 1672.

THE Discovery made about twenty years since by M. Pecquet of the *Ductus Thoracicus*, seemed not sufficient to clear up all the Difficulties to be met with in the New opinion, which this Channel hath occasion'd, concerning Sanguification.

It might be said among other things, That there appears no reason, why Nature, which does nothing without design, should carry the matter of the Blood into the *Sub-clavials*, and thence make it descend by the Trunk of the *Vena Cava*, (A,) unless it be to keep the Chyle from entring all at once and altogether pure into the Heart, and that the mixture, which is made of the Chyle with the Blood along this way, may dispose the Chyle, by a kind of contagious fermentation the

The Annotations of Dr. Needham.

(A.) I think the reas'n there mentioned to be very sufficient for the inserting of the Trunk of the *Ductus Thoracicus* into one place alone; at least as good as any that are afterwards given to prove the contrary. For, all proofs of this nature are but loose conjectures at the best: the matter admitting of no other demonstration than what is ocular.

(B.) Till the Lower insertion be shewed, we are bound to believe, that Nature thought the single more

more easily to receive the character of the Blood in the Heart : But that this might be more conveniently done, the *Ductus Thoracicus* being inserted into that trunk of the *Vena cava* which ascends to the Heart, because that this way is shorter, and is equally favourable to this commixture.

It might also be objected, that, supposing this commixture were of importance, the *Ductus Thoracicus* should communicate with the inferior trunk of the *vена cava* as well as with the superior, to the end that the moiety of the Chyle being mixt with the blood that comes from on high, and the other moiety with the blood that comes from beneath, (B) it might the more easily be altered by this commixture. And this Objection seemed the more rational, because, it being very likely that the Blood, which returns from the parts in which it hath received some impression in penetrating their porosities, communicates to the Chyle these same dispositions ; there was reason to desire, that the Blood which re-ascends might in some degree impress the peculiar character of the inferior parts, as that, which comes from the upper parts, impresses upon it that which belongs to it.

(C.) Add hereunto, that the Blood which re-ascends to the Heart, must be more perfect than that which descends ; because it comes from being purified in the Liver, Spleen, and Kidneys ; so that it is capable to give (D.) to the Chyle good impressions.

(E.) Lastly, it might be said, that, supposing it be necessary that not only a portion of the Chyle pass through the Heart, to give it some kind of refreshment, but also that all the Chyle be conveyed thicker for to be converted into Blood ; the small orifices, which the *ductus thoracicus* hath in the subclavials, seem not to

commixture of Blood and Chyle sufficient. The reinforcement of that Objection answers it self, being proposed in no other terms than (it seems very likely;) the whole conjecture having yet bad but very slender foundation in Philosophy. And if there be any thing in the notion of impressing characters, it is more attributable to the lympha. See beneath lit. D.

(C.) That the Blood, which re-ascends to the Heart, is purer than what descends from the Head, &c. is a notion that will not easily be granted, neither can it be made out by Experiment. I have my self compared the Blood of the Jugular vein with that of the Crural in a Dogg, and found no difference. The separations made by the Kidneys and Liver (if they prove any thing) prove the ascending blood to be thicker than the descending ; it having lost in those places much of its serum and its lixivial salts, which are the great instruments of attenuation. But withall it is to be considered, that the Blood, which ascends from the Heart to the Head, parts with much excrement in the glandulæ salivales, and nostrils, and the whole throat ; the quantities of which are much greater than will easily be imagined. There is like-
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be large enough for that purpose.

(F.) The Observations, that have been made in the beginning of this year in his Majesties Library, by searching carefully the passage of the *Ductus Thoracicus* in the Body of a Woman, did shew, that these difficulties were well grounded. For, it hath been found by divers Experiments, made about this matter, that there ascends at least so much Chyle through the Trunck which is beneath the Heart, as there descends through that which is above it.

These Experiments have appeared considerable, in regard that they confirm those, which were also made by the same Royal Academy of the Sciences about five years since, and which were inserted in the 7th *Journal des Scavans* 1667 *. But

this last Experiment hath been clearer and ampler then the first, in that the Communication, which the first time appeared to be only with the left *Emulgent Vein*, hath been found this second time not only with this vein, but also with the two *Lumbary veins*, which are inserted in the Trunck of the inferior *vena cava*.

As to the manner of proceeding, in the presence of the whole Company, for finding this Communication, it was this: After there had been shewed the Commerce of the *Ductus thoracicus* with the Right Ventricle of the Heart by an injection of Milk, which having been syringed into the beginning of this Channel, issued in great quantity through this ventricle; we tyed the Trunck of the *vena cava* above the Heart, so that nothing might pass that way; and the Trunck of the *Emulgent* and that of the *Vena Cava* having been opened above long wise, some milk, ready to boyl, was (G.) injected

*See Numb. 25. of these Tracts p. 461. where those Experiments were English'd.

wise a great separation made in the brain; which whether it be of the purest and best spirits of the blood, so as to leave it depauperated; or only of a nutritious serum, such as is made in all the solid parts, is hard to say. Only this may be certainly said, that the Lympha does wholly exonerate it self into the sub-clavial and angular veins near the place of the insertion of the Chyle; whereby the whole Chyle is diluted, and the mixture of it and the blood facilitated. Which very phænomenon is a greater argument to prove, that the Chyle does wholly enter by that passage, than any can be produced on the other side. For we see, all the Lympha, not only of the Liver and Intestines, but also of the lower limbs, to pour it self into the receptaculum chyli, and not into any of the lower veins: Whereas the Lymphaticks of the Head, Neck, and Arms, think it sufficient to meet the Chyle at the place of its entrance; which same thing might have been done by the lower Lymphaticks, had they any Chyle to meet: The principal use of the Lympha seeming to be, to serve the uses of the Chyle and its mixture with the Blood.

(D.) What impressions are made on the Blood by the Liver, Spleen, Kidneys, &c. is into

into the *Emulgent* through the left *Lumbar* vein (which we have ever observed to come from the *Emulgent*,) and at the same time we saw it come away through the other *Lumbar*.

This Experiment having been several times repeated without our being able to see the track, which we had observed under the *Pleura*, when the first Discovery of this Communication was made; which track seemed to shew the way, which the *Thoracick* branch keeps to entertain a communication with the *inferior venae cavae*: We resolved to attempt a more easie and a more certain method of discovering this branch, than the usual dissection of the vessels, performed by severing their proper tunics from a multitude of membranes and fatnesses, which lying and embarrassing them, render this work very difficult; especially when the vessels are not filled with blood to make them visible, and because they are composed of more delicate tunics, than those of the Veins.

(H.) This way was, to syringe into the Trunck of the *ductus thoracicus* a Composition, that might run into it being hot, and which by being refrigerated might become solid enough to afford a greater facility to follow and trace the channels, in the cavity of which it should be thus hardened. And this design succeeded in part. For, the Composition filled the whole *ductus thoracicus*, and ascended as far as into the *sub-clavial*; but there passed nothing into the channel that makes the communication sought for, though care was had to warm the ambient parts by several injections of warm milk, to the end that the Composition might not harden before it had penetrated into all the conduits. We also tryed to inject the same Composition through the *Lumbar* that issues out of the Trunck, if its valves would permit it; but they stopp'd all that we endeavoured

uncertain: But if there be any such made, the *Liver* and *Kidneys* do so readily exonerate themselves into the *vena cava*, that the impressions; be they what they will, are quickly conveyed to the *Heart* without any great diminution of them. And whereas the Author mentions the characters impressed from parts; those, (if any such be) may more justly be supposed to be conveyed in the *lympha*, which liquor seems to be a product of those parts curiously elaborated in the very substance of them.

(E.) What is sufficient and not sufficient, must be judged of by *Nature*, and not by *Us*. Yet, if we consider the time that is spent in carrying the *Chyle* up into the *Blood*, it is easie to believe, that a much greater quantity of liquor may be discharged by that *ductus*, than is usually pretended to.

(F.) What those Experiments are, we should be glad to know. But the Experiment of 1667 (if I rightly remember it) was only a *lucus naturæ*, found by *M. Pecquet*. Which I therefore call so, because neither he, nor any one else hath found it since: whereas the *visa lactea*, and the waies of ordering them, are so well known, that, if any such thing were, it could not long be hid.

(G.) An Injection into the *Lumbar* vein with its effects

to make pass that way, and neither the milk nor the wind would ever enter there.

(F.) The advantage we had from the Injection of this Composition into the said *Ductus*, was, that we very distinctly saw the figure and the whole structure of it, when the Composition wherewith it had been filled, was refrigerated and hardened. For we found, that that *ductus* did ascend unto the right side of the heart, keeping one and the same size, which was no more than $\frac{1}{2}$ of an inch; that afterwards it was enlarged to $\frac{5}{8}$ of an inch in diameter; that in this enlargement its tunicle on the right side of the *vertebra* was, as 'twere, pierced by four small holes, distant $\frac{1}{2}$ of an inch from one another, and all disposed in a row; into which holes the said Composition had not been able to penetrate; that the same *ductus*, after having retaken its first size, had two appendixes fashioned like sacks; that there was yet a third appendix beneath the dilatation; that the first and highest appendix was of the form and bigness of a small *phaseolus*; that the third, which was beneath the dilatation, was like to the second; that they had all a streight orifice; and that the last was full of chyle consipitate, so that the Composition could not enter there, as it had done into the other.

The Importance of these Observations ought to incite the Curiosity of those that are addicted to Anatomical researches, and to engage them to examin with care this New communication, to attain at last a clear accompt thereof.

contrary, viz. all the *Lateral* vessels (that are acknowledged to be such,) fully distended: Which is a full demonstration, that they have no way of evacuation by any other duct than the *thoracique*.

(G.) The other use of the coagulating Injection I appland; though the same may be done by the Ligature above said. However the event of the Experiment, made by the Learned Pecquet, makes against the opinion of a New *ductus*, and not for it; as appears by the Narrative.

This haste, in which this was written, begs your excuse.

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effects mentioned can prove nothing but the *Inosculation* of the two *Lumbary veins* with each other: which is acknowledged to be such in all the *Capillary vessels* of the same kind, viz. *Veins* with *veins*, and *Arteries* with *arteries*. But the thing required here is, the passage from the *Receptaculum* to the *Lumbary vein*, or to any other vein besides the *Subclavial*.

(H.) The way of syringing a liquor, which is apt to coagulation, into the *ductus thoracicus*, &c I think to be needles and unprofitable as to this Inquiry, when there is a more easie Experiment to be made, which is more demonstrative, viz. Open a Dog at a convenient distance of time from his feeding, and then tye a ligature upon the *ductus thoracicus* nigh the *Sub-clavial*: your *receptaculum chyli* will continue full, 48 hours or longer, if you please: So that, if there be any such *ductus*, it must remain likewise full with its own natural liquor, and be all that while visible. But, if there were any such *ductus*, it would in a quarter of the time empty the whole receptacle; whereas upon a ligature you'll find the clean con-

trary, viz. all the *Lateral* vessels (that are acknowledged to be such,) fully distended: Which is a full demonstration, that they have no way of evacuation by any other duct than the *thoracique*.